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RHINO Morphological and DIAGNOST functional precision diagnostics of the nose

Walter Koch, Odo Benda, Ramiro Ortiz:

CFD-Simulation – a Rhinodiagnost Service

Angewandte Informationstechnik Forschungsgesellschaft mbH

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ANGEWANDTE INFORMATIONSTECHNIK Forschungsgesellschaft mbH | Sutter Precision Electrosurgery Made in Germany | AIA Institute of Aerodynamics and Chair of Fluid Mechanics | RWTH AACHEN UNIVERSITY | JÜLICH Forschungszentrum | JÜLICH SUPERCOMPUTING CENTRE | medCONTACT GmbH

IraSME | ZIM Zentrales Innovationsprogramm Mittelstand | FFG | bmwfw Bundesministerium für Wissenschaft, Forschung und Wirtschaft

Objectives

Development of Services (and Products) supporting Diagnostic Activities of ENT-Experts and Using CFD-Simulations

Services:

- **Upload of CT-Scans onto a PACS Server (DICOM-Format)**
- **Creation of 3D-Models**
- **CFD-Simulation**
- **3D-Print Services**
- **Volumetric Services for Paranasal Sinuses („Swelling“) (except: ethmoid cells)**

Products:

- **Nasal Airflow Simulator**

Service Platform

Services

Welcome to the Rhinodiagnost Service Platform

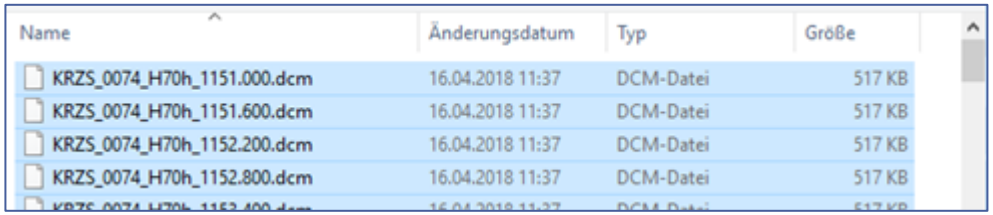
The Rhinodiagnost Service platform offers various services for uploading CT images and creating 3D Models of the nasal and paranasal cavities. Please be aware that this is a test site.

3D Mesh Visualization Service

You can upload DICOM images which are then stored on an Orthanc Server. A 3D model of the nasal cavities is produced and the various nasal cavities are separated in the model. As one first result the service delivers a visualization of the swelling of tissue within the nasal cavities.

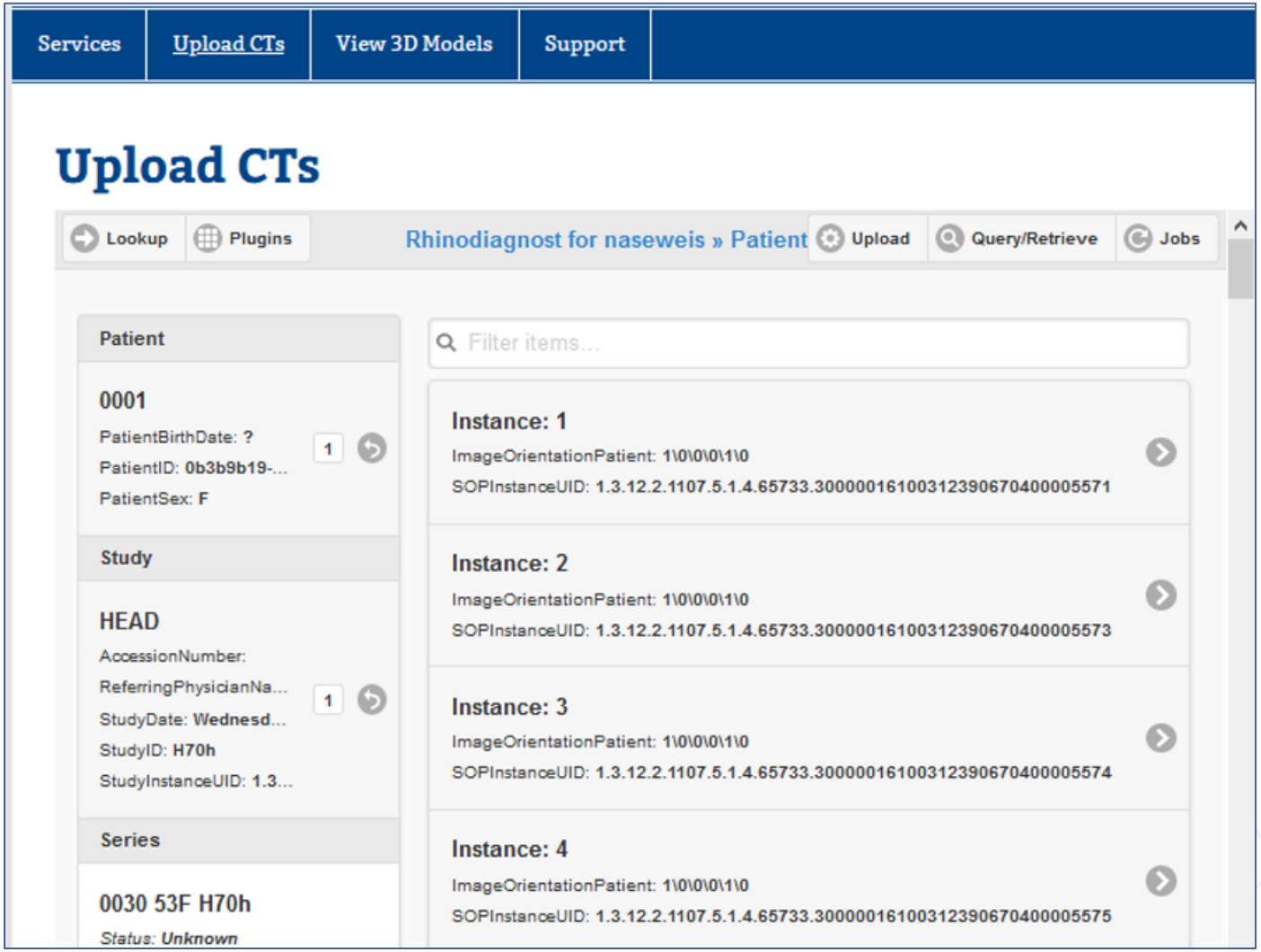
Service: Upload of CT-Scans

- Directly over the Internet (online-service)
- Offline via a storage medium (e.g.USB-device, CD-ROM,…)
- Data can be anonymized and will be stored on the Rhinodiagnost-PACS-Server (OpenSource)

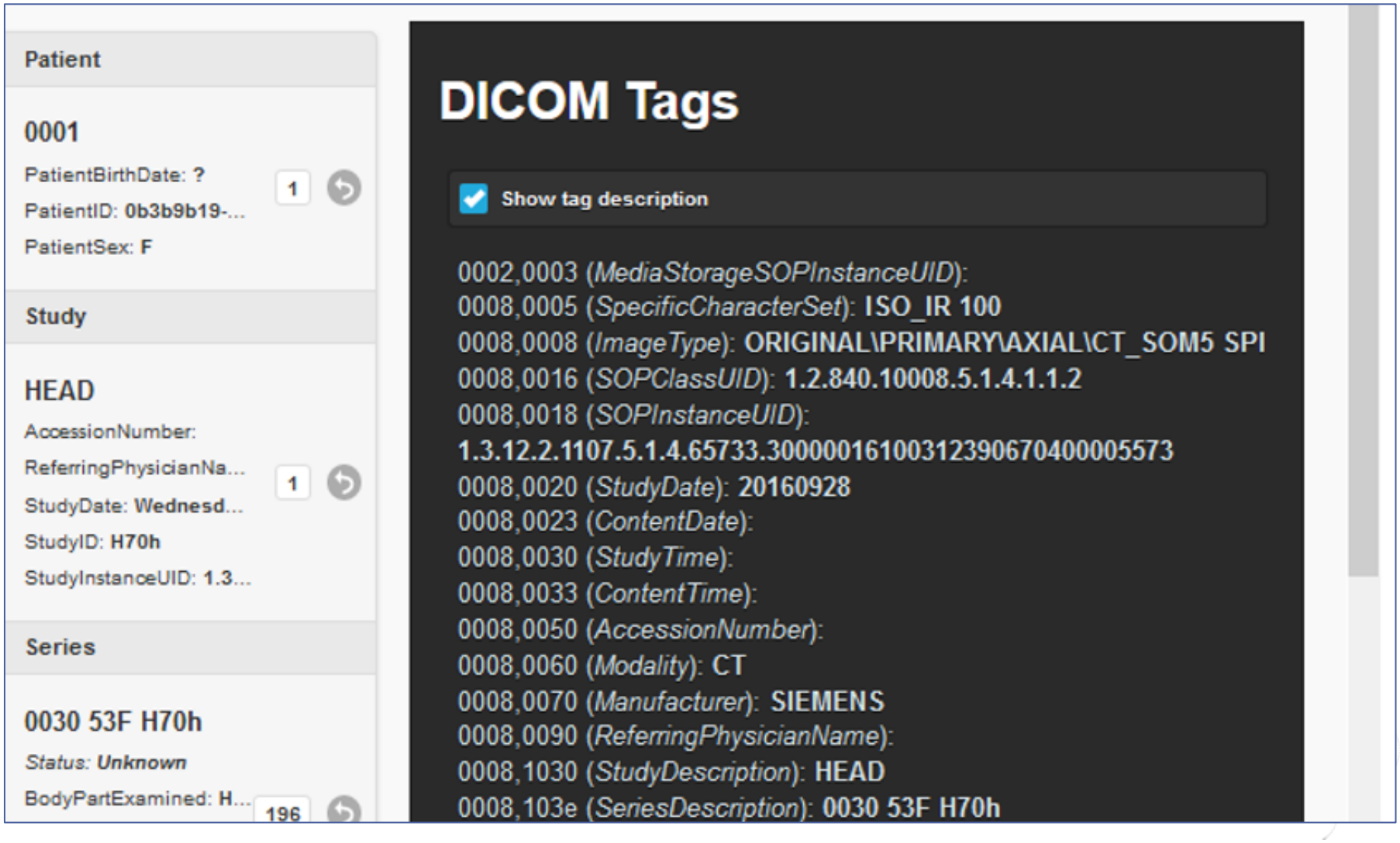


Management of DICOMs (1)

Inspection of uploaded Data

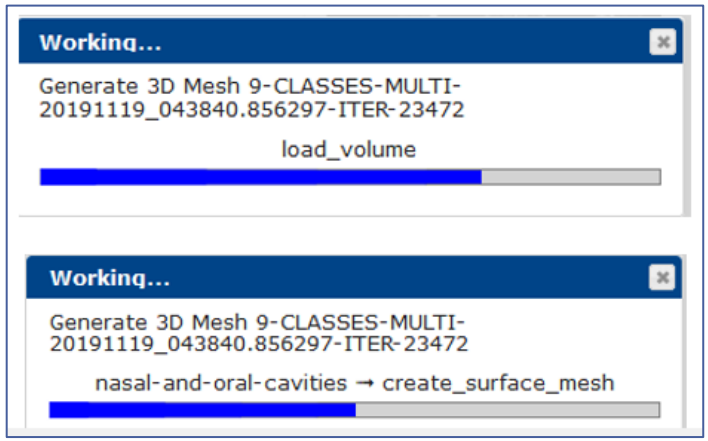


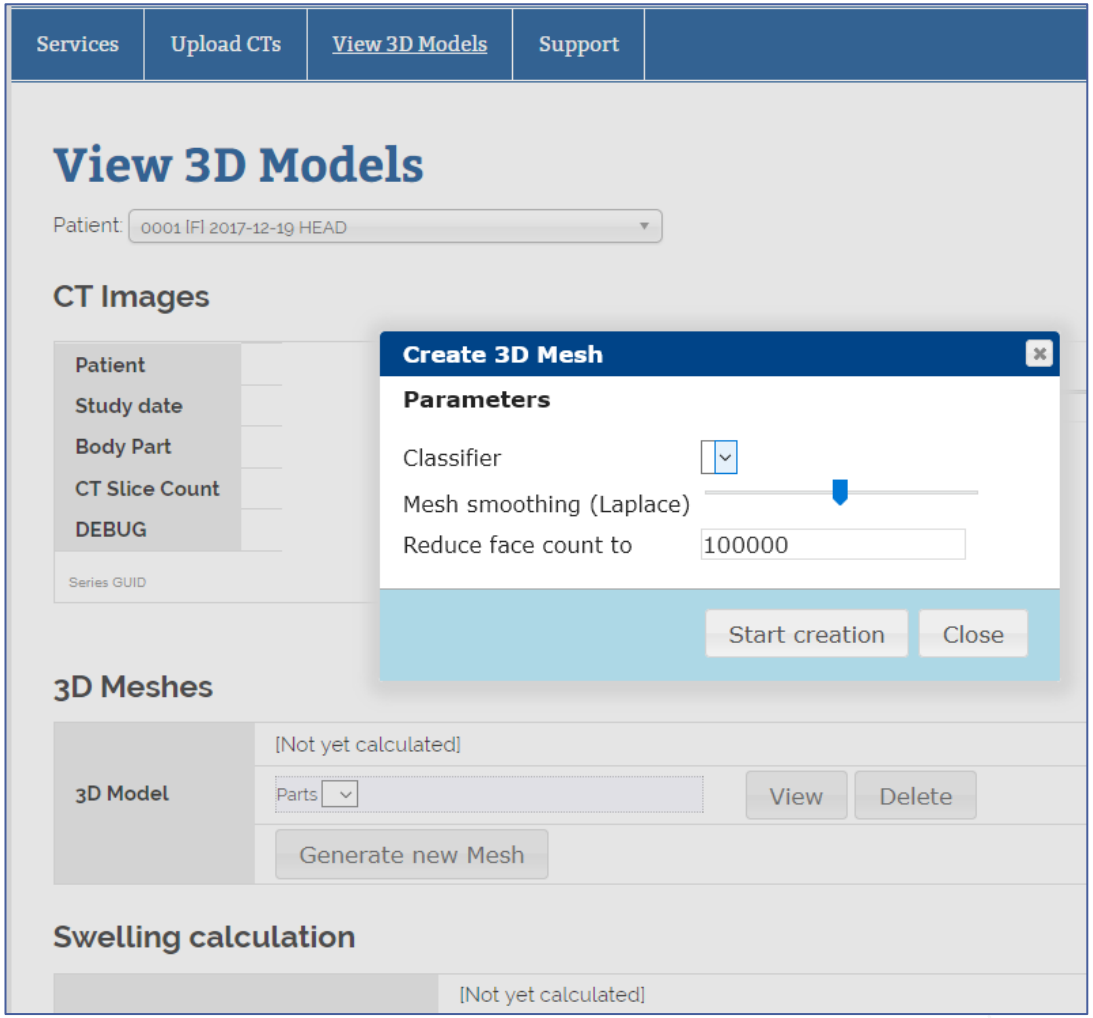
Management of DICOMs (2)



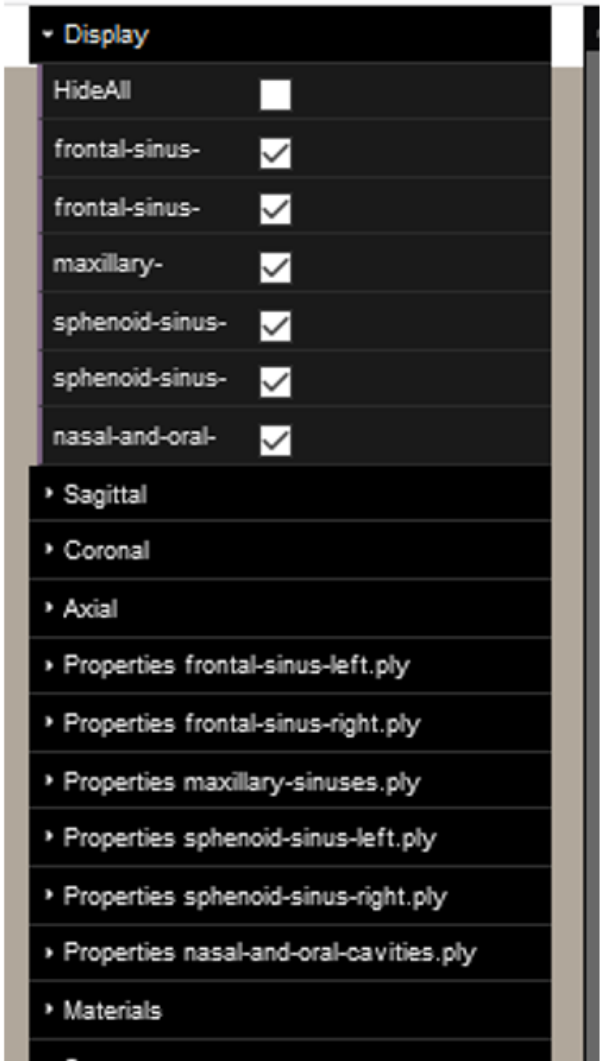
Service: 3D-Model Creation

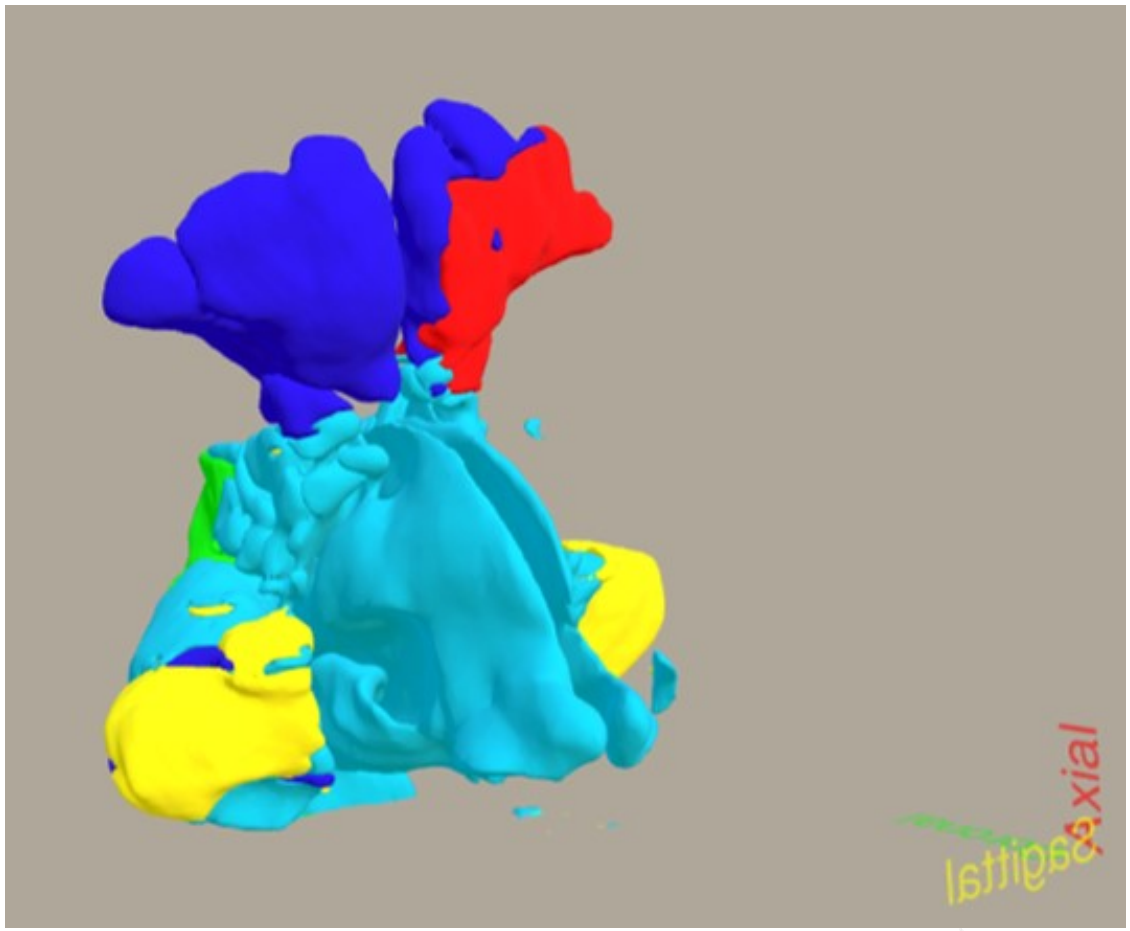
Entry of Parameters for the Mesh (3D-Model) Creation





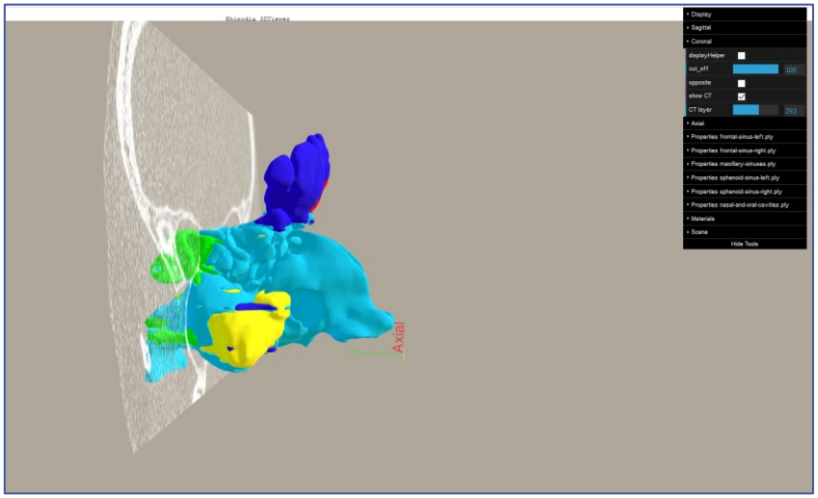
3D-Model: Tools (1)





3D-Model: Tools (2)

Different views



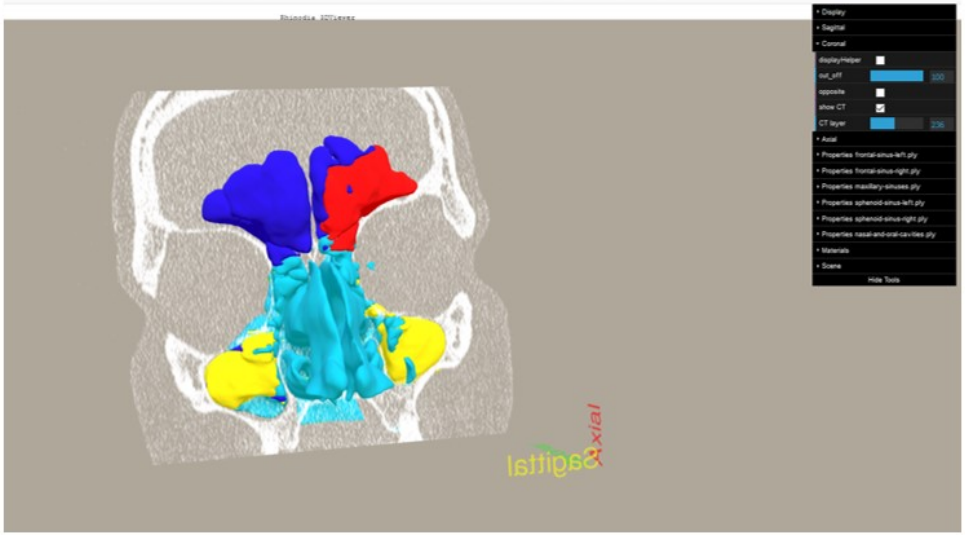
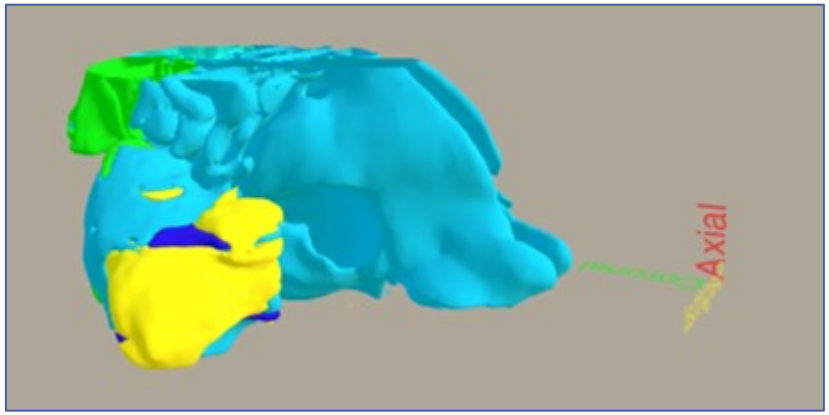
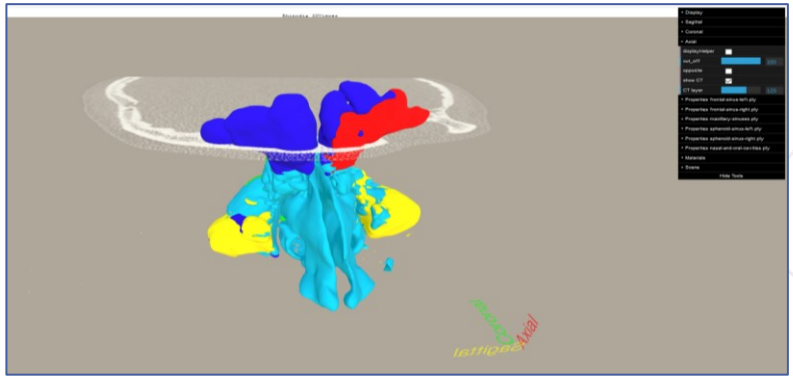


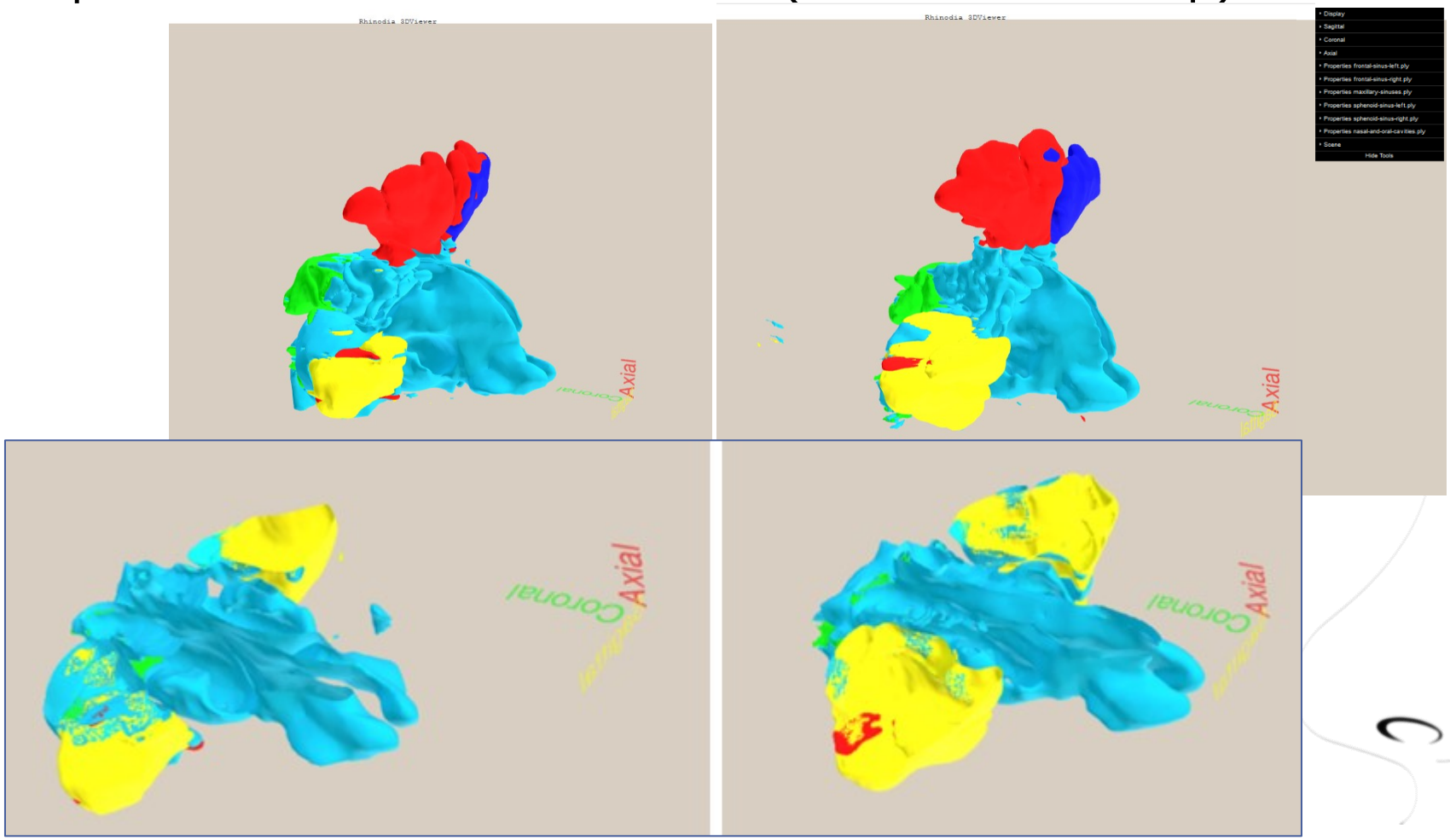
Figure 20: Show CT





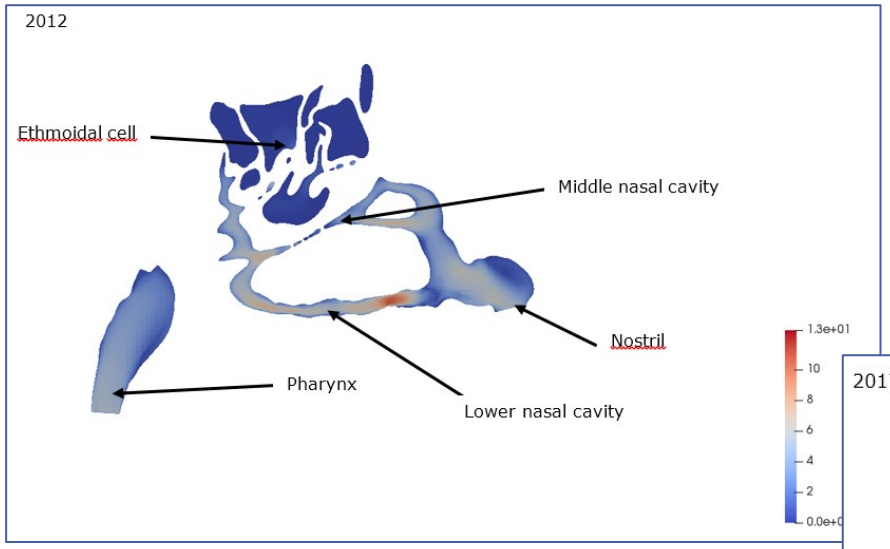
3D-Model: Tools (3)

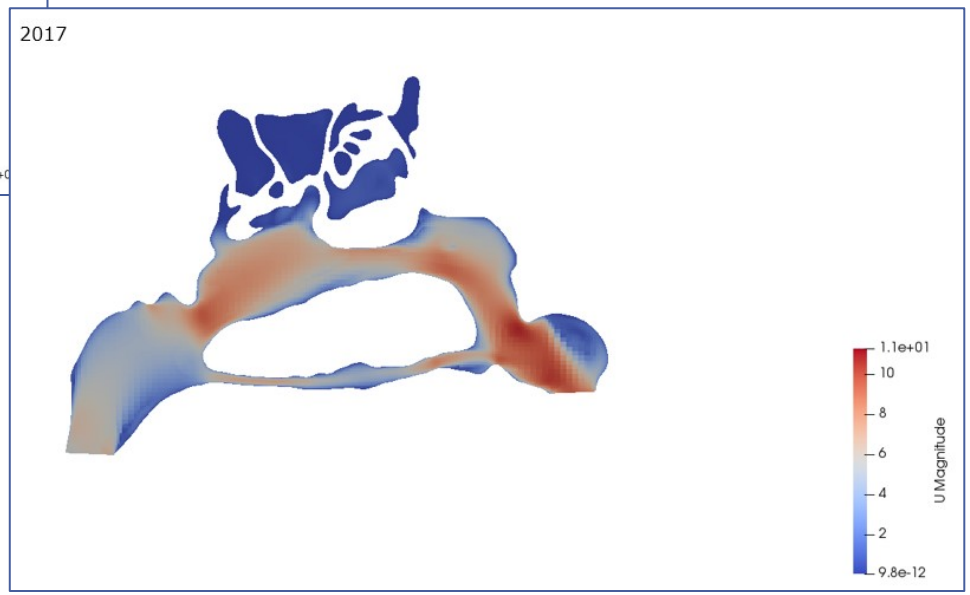
Compare ROIs of different Patients (Data Base Lookup)



Service: CFD-Simulation (1)

Air flow velocity (absolute) on certain slices through the nasal cavities. Sagittal view of 3D model displayed in ParaView. View through the right side of the nasal cavities

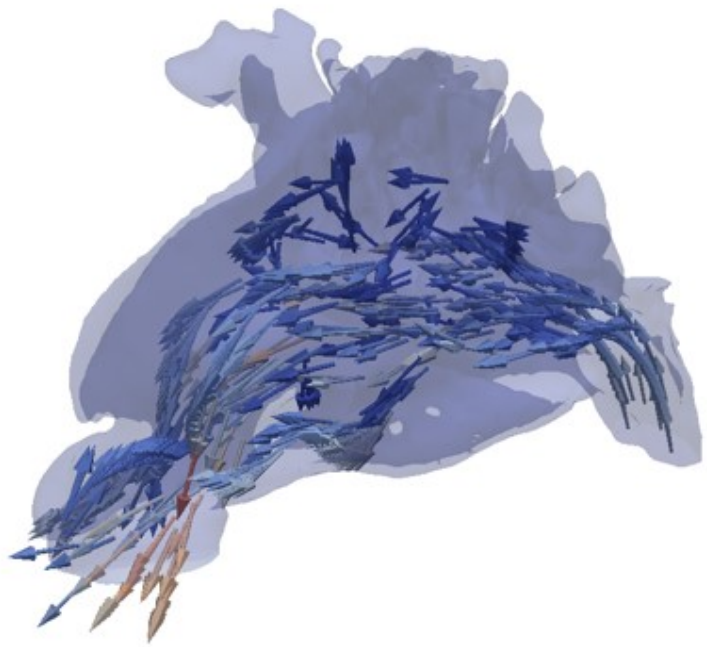
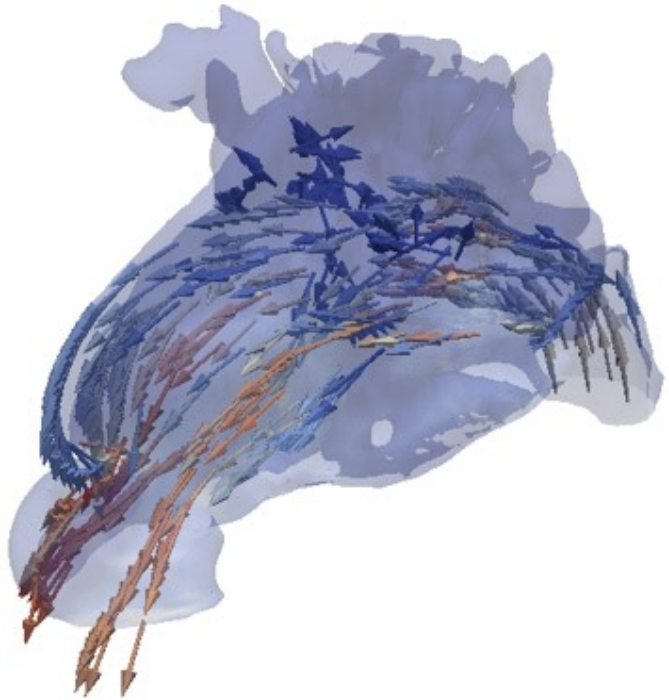




Service: CFD-Simulation (2)

1.2.4 View of the air velocity along stream lines

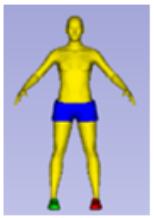
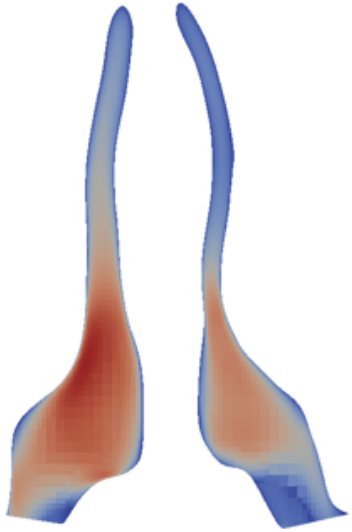
Left side view (sagittal)

2012	2017
	

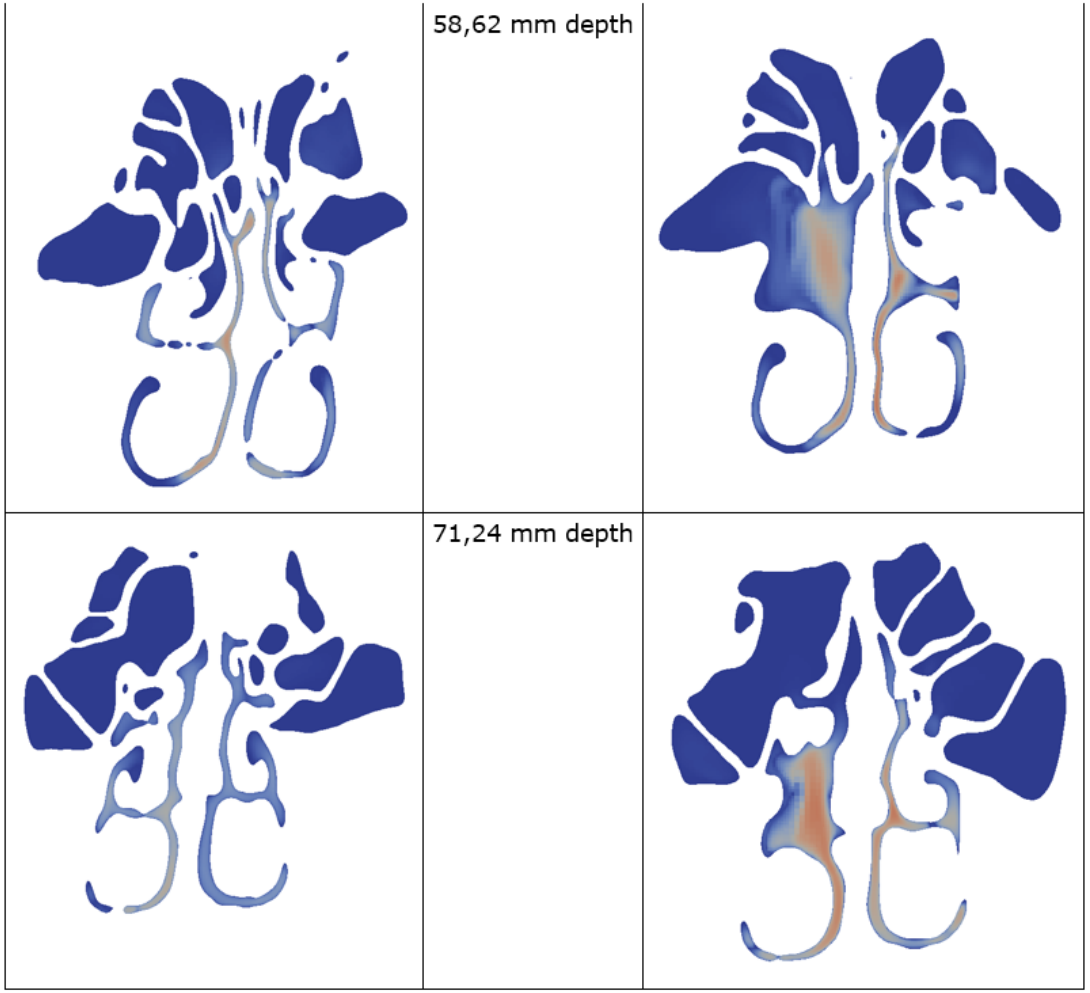
Service: Simulation Report (1)

1.2.3 View from the front in several distances

coronal view

2012		2017
R L	18,31 mm depth 	

Service: Simulation Report (2)



Service: 3D-Print

- 3D-Models are stored in the Rhinodiagnost (RD)Workspace as STL-Files
- STL-Files can be downloaded on the Personal Computer
- STL-Files can be sent to an RD-Partner for Printing



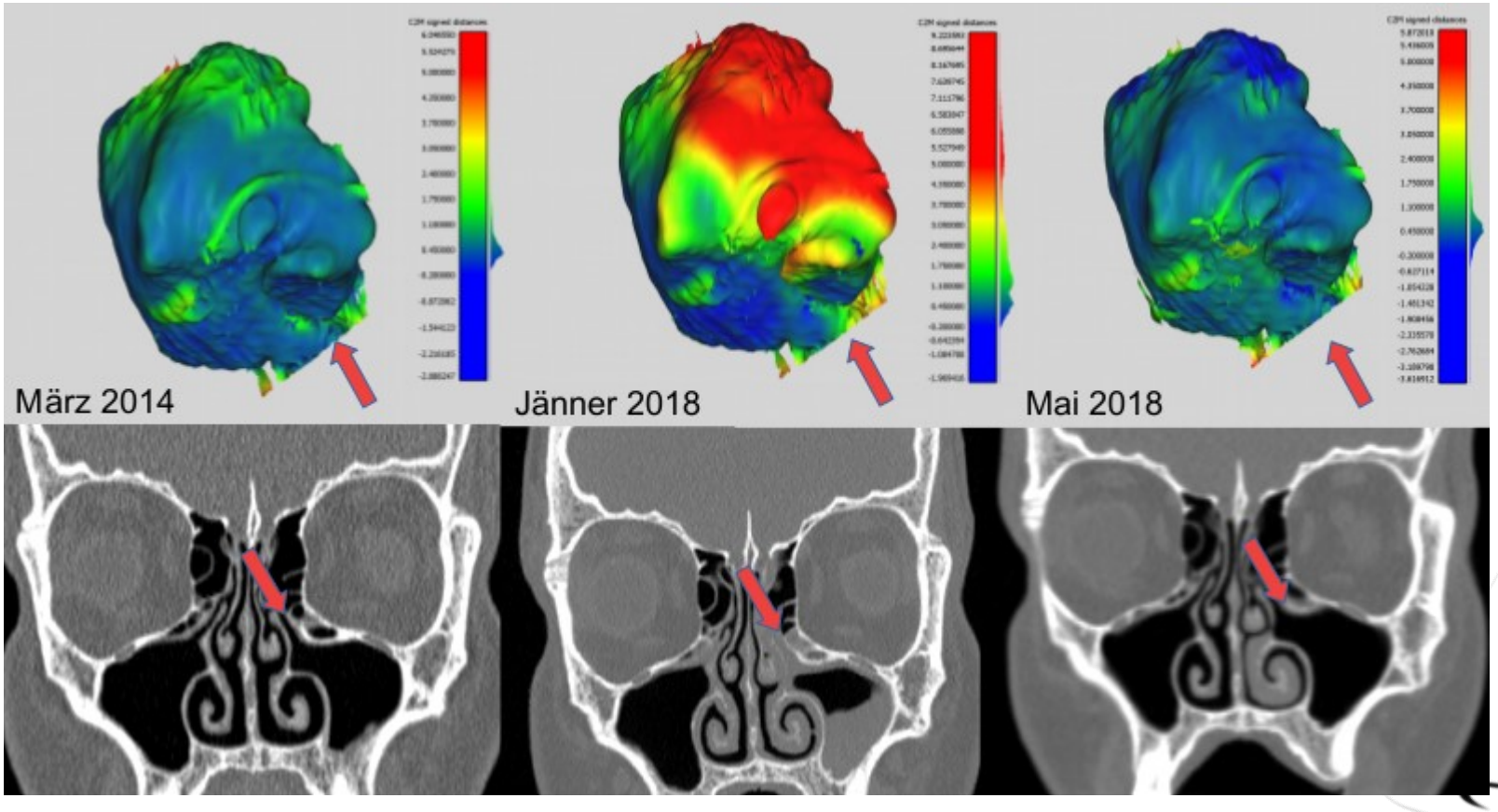

Service: Volumetric Meas.(1)

- Available for Paranasal Sinuses:
  - Maxillary Sinus
  - Frontal sinus
  - Sphenoid sinus

- The distance between the inner surface of the bone around a cavity and the surface of a cavity itself (surface of the air mesh) can yield information about pathological obstructions. Furthermore, volumes, changes in volume and differences between volumes can be computed.

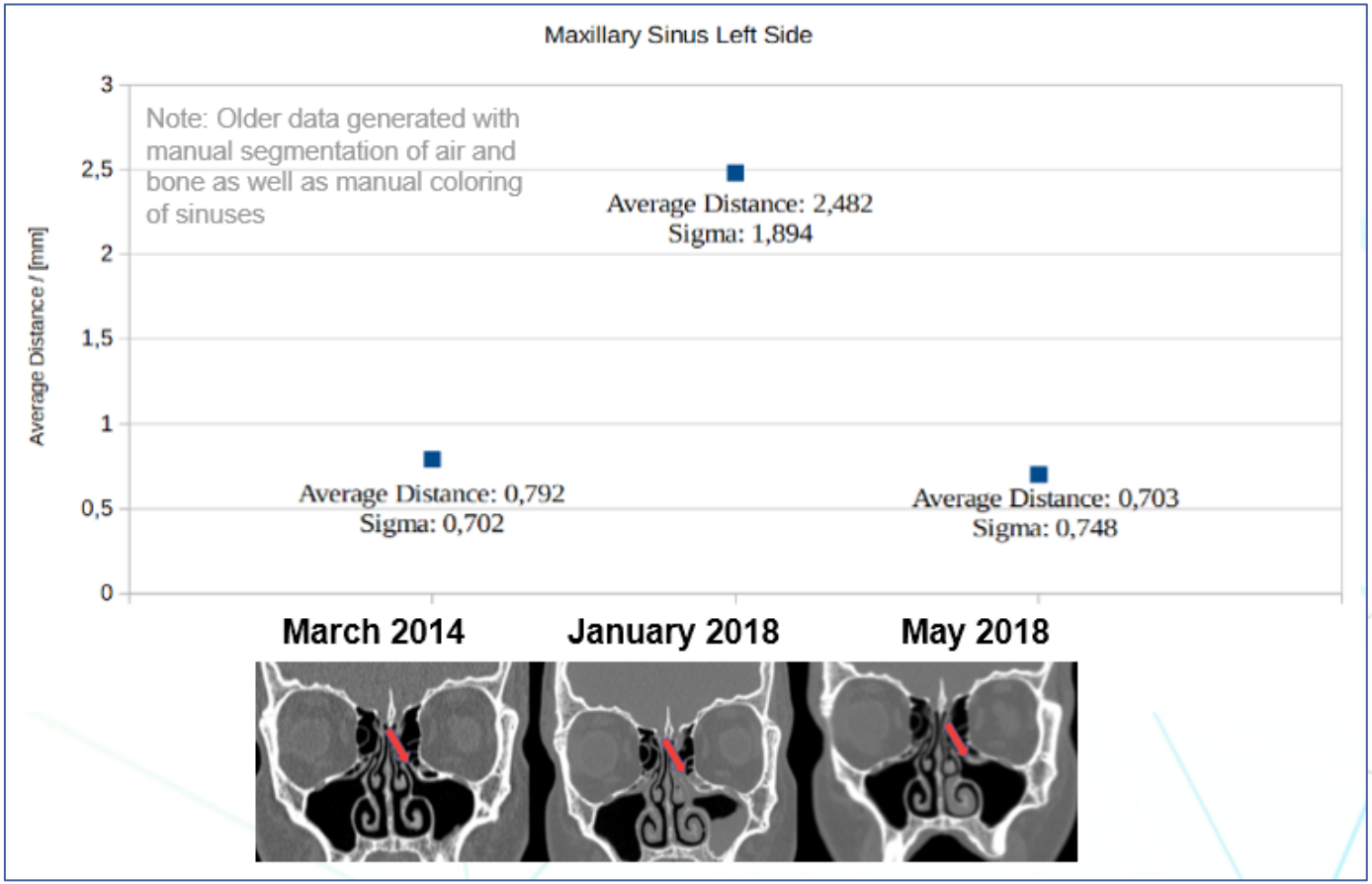
Service: Volumetric Meas.(2)

Distance: red = high value blue = low value

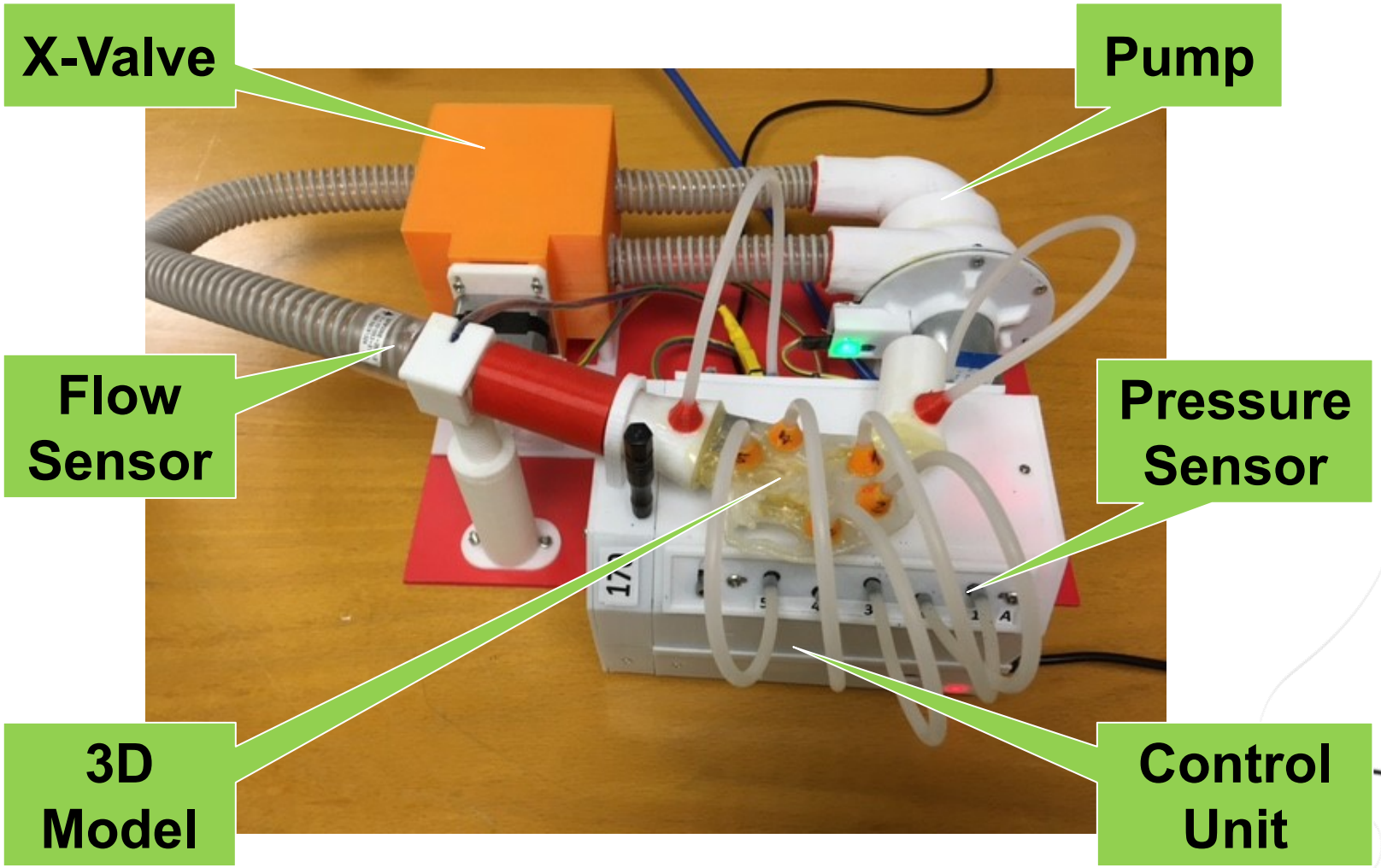


Service: Volumetric Meas.(3)

Increase in average distance between bone and cavity of sinus suggests pathological change.



Product:Nasal Airflow Simulat.

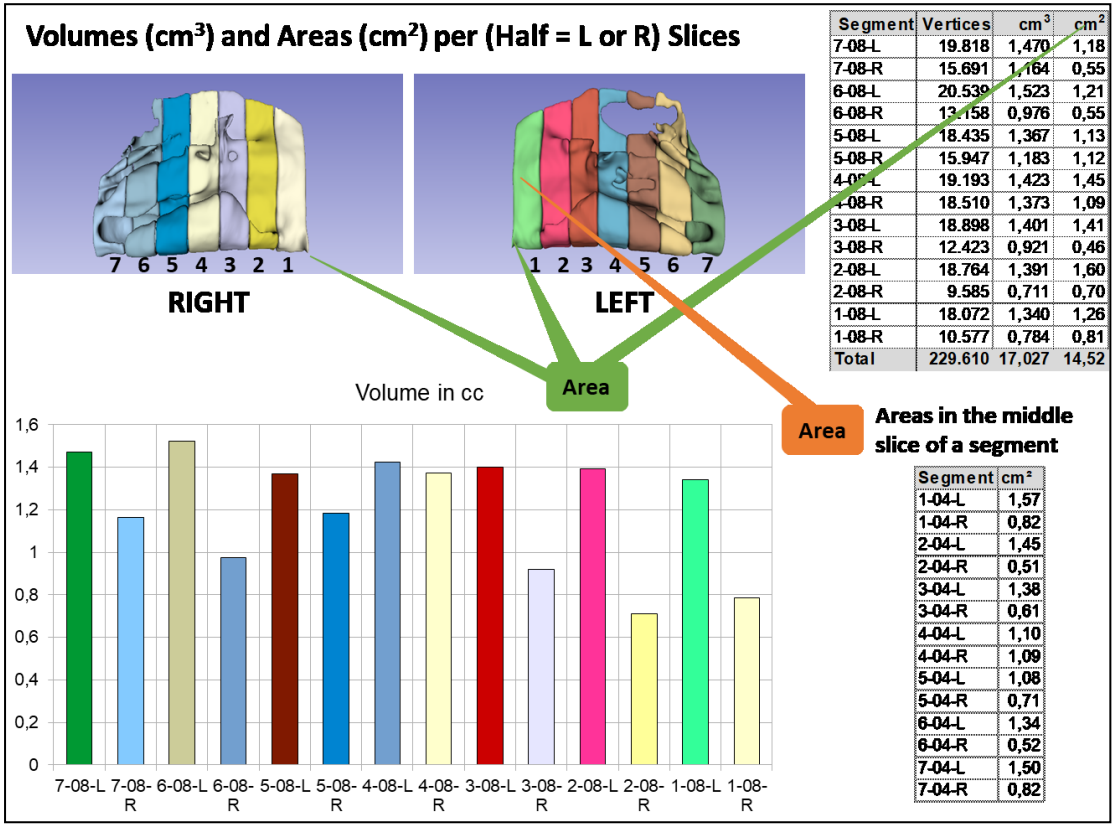


Nasal Airflow Simulator (NAS)

NAS-User Interface

In the Pipeline

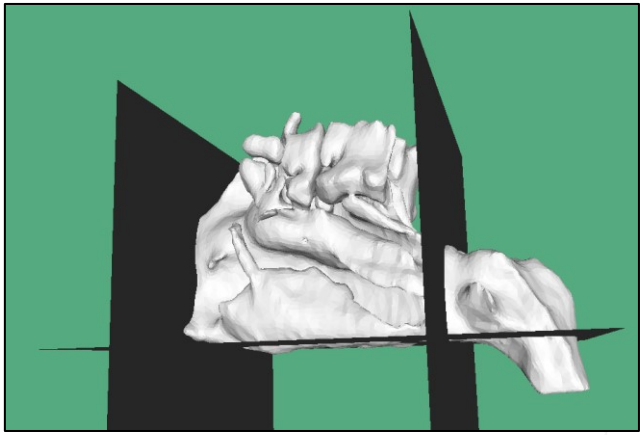
Calculation of the Nasal Resistance in Segments („Main" Nasal Cavities)

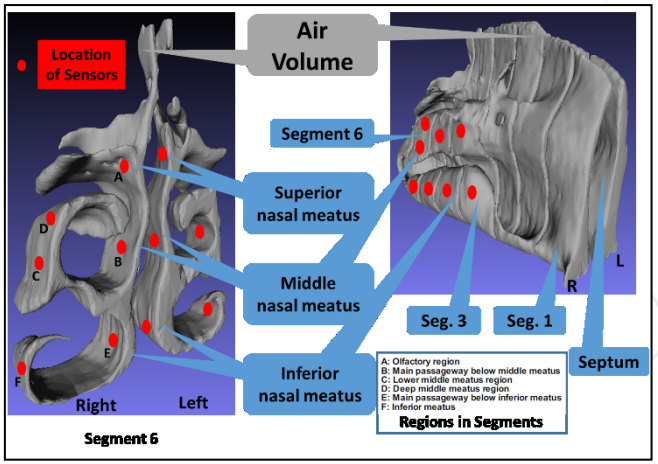


Segment	Vertices	cm³	cm²
7-08-L	19.818	1,470	1,18
7-08-R	15.691	1,164	0,55
6-08-L	20.539	1,523	1,21
6-08-R	13.158	0,976	0,55
5-08-L	18.435	1,367	1,13
5-08-R	15.947	1,183	1,12
4-08-L	19.193	1,423	1,45
4-08-R	18.510	1,373	1,09
3-08-L	18.898	1,401	1,41
3-08-R	12.423	0,921	0,46
2-08-L	18.764	1,391	1,60
2-08-R	9.585	0,711	0,70
1-08-L	18.072	1,340	1,26
1-08-R	10.577	0,784	0,81
Total	229.610	17,027	14,52

Areas in the middle slice of a segment

Segment	cm²
1-04-L	1,57
1-04-R	0,82
2-04-L	1,45
2-04-R	0,51
3-04-L	1,38
3-04-R	0,61
4-04-L	1,10
4-04-R	1,09
5-04-L	1,08
5-04-R	0,71
6-04-L	1,34
6-04-R	0,52
7-04-L	1,50
7-04-R	0,82





Programme for 2021

- Continuation of MoU Arrangements
- First Half of 2021: Stepwise Introduction of Services
- MoU Partners can use all Services Free of Charge (Fair Use)
- First twenty 3D-Printed Models are Free of Charge
- In co-operation with the Medical University Vienna introductory courses for Rhinodiagnost (RD) Services will be offered (Webinars)
- An RD-Newsletter can be subscribed
- New partnerships for R&D-Projects are welcome:
  - Development of a Treatment Simulator
  - 3D-Print of personalized Instruments

Thank you!

Walter Koch

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